2020-08-27

Simulation and performance analysis of municipal solid waste gasification in a novel hybrid fixed bed gasifier using Aspen plus

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Taylor & Francis Online

https://doi.org/10.1080/15567036.2020.1806404

Simulation and performance analysis of municipal solid waste gasification in a novel hybrid fixed bed gasifier using Aspen plus

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DOI: https://doi.org/10.1080/15567036.2020.1806404

ABSTRACT

Thermochemical conversion technologies (incineration, gasification, and pyrolysis) have emerged as potential technologies for municipal solid waste management. Incineration is the most common thermo-chemical technology widely used in developing countries; however, the process pollutes the environment. Therefore, this study suggests a novel hybrid fixed bed gasifier for gasification of municipal solid waste (MSW). The gasifier model was developed using the Advanced System for Process Engineering Plus (ASPEN Plus) software to accommodate the four gasification stage (drying, pyrolysis, combustion, and gasification). The aim of developing a novel hybrid fixed bed gasifier is to combine the advantages of downdraft and cross-flow gasifiers in one system and minimize its disadvantages. This combination has revealed the way to a gasifier design that accommodates feedstock with high moisture content (≈ 60%) while maintaining or improving syngas output composition. The analysis of operating parameters such as temperature and equivalence ratio (ER) was also investigated. The results showed that the moisture content (MC) was reduced from 59.8 wt% to 6.8 wt%. The syngas output was highly affected by the changes in temperature as well as ER. High temperature increases H2and CO output composition. The behavior was different for the case of ER where it was observed that H2 and CO decreases while CO2 andH2Oincreases between ER = 0.1 to 0.4 and then starts decreasing gradually. In general, the developed hybrid fixed bed gasifier exhibited an increase inH2 and CO in the producer gas. At this situation, the carbon conversion efficiency of 62.35% and a gasifier conversion efficiency of 54.5% were realized. This suggests the suitability of hybrid

KEYWORDS: Municipal solid waste; thermochemical; gasification; Aspen plus; fixed bed gasifier